

# Immigrant Asian Indians in the U.S.: A Population at Risk for Diabetes and Cardiovascular Disease

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## Abstract

Asian Indians are the third largest and fastest growing Asian subgroup in the U.S. and considered the model minority due to their high education and income level. Unlike other Asian immigrants, they are a more heterogeneous group with a genetic predisposition for diabetes and cardiovascular disease. Current national surveys are incapable of assessing risk factors and disease prevalence in specific Asian sub-populations because multiple ethnic groups are aggregated into the general category of "Asian and Pacific Islander," and because sample sizes of individual Asian sub-groups are small. This literature review highlights the need for large population-based studies to examine prevalence rate and changes in clinical and non-clinical risk factors for diabetes and cardiovascular disease among the growing immigrant Asian Indians in the United States. Implications for primary and secondary prevention and health promotion/health education are discussed.

## Introduction

While Asian Americans make up about 5% of the U.S.'s population (as of May 2005), they are one of the fastest growing racial/ethnic groups (in terms of percentage increase) in the U.S. According to the 2004 Census Bureau population estimate, there are 13.9 million Asian Americans living in the United States (OMH, 2006). In 2000, 12.9 million reported themselves as having either full or partial Asian heritage. The largest ethnic subgroups are Chinese (2.7 million), Filipinos (2.4 million), Asian Indians (1.9 million), Vietnamese (1.2 million), Koreans (1.2 million), and Japanese (1.1 million). Other sizable groups are Cambodians (206,000), Pakistanis (204,000), Laotians (198,000), Hmong (186,000), and Thais (150,000) (Asian-American Market Profile, 2004).

Type 2 diabetes mellitus (T2DM) and cardiovascular disease (CVD) are important chronic diseases that have reached epidemic proportions in both industrialized and non-industrialized countries and are a significant public health problem. The prevalence of diabetes (worldwide) is projected at 300 million by 2025, an increase of 120% (King, Aubert, & Herman, 1998). The brunt of this increase (more than 80%) will be borne by the developing countries. Several factors have been implicated for this increase: population

growth, genetic predisposition, high illiteracy rate, poverty, and sociological changes that impact lifestyle behaviors. Migrant Asian Indians (AIs) in the U.S. have an unusually high predisposition to develop both T2DM and CVD (King et al., 1998; McKeigue, Ferrie, Pierpoint, & Marmot, 1993). Asian Indians in India have higher prevalence of insulin resistance, a key pathophysiological factor, despite low rates of obesity and hence genetically pre-disposed to have diabetes (Table 1).

Prevalence of T2DM among immigrant AIs in the U.S. is lacking; reliable data from national surveys are limited due to small sample sizes or aggregation of ethnic data into a heterogeneous group of Asian Americans or Asian and Pacific Islanders. Hence the purposes of this paper are to (a) review the literature regarding studies on T2DM and CVD among AIs in the U.S. and (b) highlight the importance of health promotion and health education to prevent or reduce the early onset of the disease in this ethnic group. Lack of health promotion behaviors may contribute to an already increased risk for diabetes and requires culturally oriented health education for this high-risk population.

## Asian Indians - Demographics

Asian Indians are the third largest Asian subgroup in the U.S. and comprised 16.4% of the Asian American population (Census, 2000). The majority (71%) are 18 to 64 years old, and 77% are immigrants (Census, 2000). The growth rate of 106% from 1990 to 2000 is the highest among all Asian Americans (the second fastest growth was 83% for Vietnamese Americans)(Census, 2000). Despite this increase, current research on Asian American health does not adequately address their health needs.

Unlike other Asian immigrants in the U.S., AIs constitute a more heterogeneous group than immigrants from other Asian nations. They form distinct subgroups based on differences in language (14 major languages), provinces or states of origin (28 states), religions (five major religions), and race (at least four distinct racial types) (Gupta, Misra, Pais, Rastogi, & Gupta, 2006). This is evident from the numerous, diverse Asian Indian cultural and religious associations in U.S. cities with large AI populations. Distinctly different classes, social habits, cultural practices, diets, lifestyles, and optimistic or fatalistic orientations to life characterize these subgroups. First generation AIs tend to retain the distinct languages, culture, and religious practices of their subgroups, which inhibits the development of ethnic solidarity as seen among Chinese, Japanese, or Filipino immigrants (Kar, 1995).

Further distinction between Asian immigrants and AIs lies in their educational level. AIs are generally well-

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Table 1

*Insulin Resistance<sup>a</sup> in Asian Indians Living in India*

Author & year	Study group	N	Geographic location	Measure of IR	Observations
Ramachandran et al., 1998	Men & women <sup>b</sup>	953	Chennai, South India	FI and post-glucose 120 min insulin levels	~55% age-adjusted prevalence of high 2-h insulin levels
Snehalatha et al., 2000	Non-diabetic subjects	654	Chennai, South India	OGTT, HOMA-IR	High FI: F ~54%, M 37%; ↑ 2-h insulin: F ~72%, M 51%; IR: M 11%, F 13.6%
Mohan et al, 2001	Middle & low-income groups	479 783	Chennai, South India	FI levels	High FI levels in middle income group
Snehalatha et al., 2001	Non-diabetic subjects <sup>c</sup> NGT IGT	48 51	Chennai, South India	HOMA-IR	High HOMA-IR in IGT Vs NGT (7.9 ± 4.2 vs. 6.07 ± 3.76)
Misra et al., 2002	Women residing in urban slums	80	New Delhi, North India	HOMA-IR	High HOMA-IR in ~23%; High FI levels in 26%
Deepa et al, 2003	Subjects from upper & low SES	1,070	Chennai, South India	HOMA-IR	IR ~19% in high SES; ~7% in low SES
Mishra et al., 2004	Post-pubertal school children	377	New Delhi, North India	FI levels, HOMA-IR	FI; M, 18.7 µU/L, F, 23 µU/L <sup>d</sup> ↑ FI; M, 21.8%, F, 35.8%

*Note.* FI = fasting plasma insulin; HOMA-IR = homeostasis model assessment of insulin resistance. OGTT = oral glucose tolerance test.

<sup>a</sup>Insulin resistance (IR) defined by insulin levels or its ratio with fasting blood glucose. <sup>b</sup>Aged ≥ 40 years. <sup>c</sup>Subjects with normal glucose tolerance (NGT) and impaired glucose tolerance (IGT) matched for body mass index (BMI) and waist-hip-ratio (W-HR). <sup>d</sup>Highest quartile in the study group.

educated with the highest annual household income among all Asian American immigrants. Hence, they are perceived to achieve a much greater degree of success in the U.S., and are stereotyped as the model minority (Misra, Patel, Davies, & Russo, 2000). According to the 2000 Census, the median household income is \$60,093 compared to \$41,110 for non-Hispanic Whites (Census, 2000; Rao, 2003) and 67% of foreign-born AIs have a college education compared to 21% for Caucasians (Census, 2000). Hence, AIs are perceived as having good access to health care (Misra et al., 2000). However, they are not always a model minority for health. Their level of English fluency, diet, and lifestyles vary. There are marked variations in educational attainment, income, English fluency, diet, and lifestyle among AIs. Recent immigrant cohorts comprise both highly educated professionals as well as individuals who lack education and job skills. The latter are mostly family members of earlier immigrants (Diwan, 2008). All of these factors affect the

health of AIs, especially when it comes to accessing health care, risk for T2DM and CVD, and unhealthy habits such as smoking.

### Prevalence of Diabetes and Cardiovascular Disease

Although the burden of diabetes incidence (new cases) and prevalence (all cases) have been increasing for all racial and ethnic groups in the U.S., AIs have higher rates of diabetes (generally over 10%) and diabetes-related morbidity and mortality compared to whites and other ethnic groups (Enas et al., 1996; Yusuf, Reddy, Ounpuu, & Anand, 2001). Insulin resistance is very high among migrant AIs in the U.S. (Table 2). Despite limited population-based studies in the U.S., diabetes prevalence among AIs in the U.S. is two to three times higher than the general U.S. population (Mohanty, Woolhandler, Himmelstein, & Bor, 2005; Venkataraman, Nanda, Baweja, Parikh, & Bhatia, 2004) (Table 3). However,

Table 2

*Insulin Resistance<sup>a</sup> in Asian Indians Living in US/Westernized Countries*

Author & year	Study group	Sample size	Geographic location	Measure of IR	Summary of findings
Chandalia et al. 1999	Men	44	USA	OGTT	Results show that Asian Indian men are more insulin resistant than Caucasian men independently of generalized or truncal adiposity.
Banerji et al. 1999	Men	20	USA	OGTT	Insulin action was inversely correlated with visceral adipose tissue, not total or abdominal sc adipose tissue.
Chambers et al. 2001	Men	1,025	UK	Insulin resistance score was calculated as the sum of 2 scores for systolic blood pressure, fasting glucose, waist-hip girth fat 10, HDL cholesterol, and fasting triglycerides.	CPR concentration was 17% higher in Indian Asians than European whites.
Dhawan et al. 1994	Men	200	Manchester, UK; New Delhi, India	Fasting insulin & HDL Concentrations were independent predictors of coronary artery disease in white men, where as in British Asians the waist to hip ratio was the strongest independent predictor.	Asians in UK and in India had higher prevalence of diabetes & impaired glucose tolerance than white British men.
Abate et al. 2004	Men	140	USA	OGTT	Plasma concentrations of adipose tissue metabolites leptin & NEFAS are higher & that of adiponectin is lower in IR Asian Indians compared with more insulin-sensitive Caucasians.
Laws et al. 1994	Men & Women	22	USA	OGTT	Both sexes were consistent w/ resistance to insulin suppression of free fatty acid levels in Asian Indians. They also had higher fasting plasma triglyceride & lower HDL cholesterol concentrations than men/women of European ancestry.

*Note.* OGTT= oral glucose tolerance test; HDL = high density lipoprotein; NEFAs = nonesterified fatty acids; IR = insulin resistance; CPR = C-peptide immunoreactivity.



the risk factors for developing T2DM have not been systematically assessed in a population-based perspective and random studies among migrant AIs, nor have changes in these risk factors as they acculturate to western society received attention. Mohanty and her colleagues (2005) analyzed the National Health Interview Survey (NHIS) data from 1997-2000 for prevalence of diabetes, obesity, coronary heart disease, and hypertension among AIs and reported that AIs had significantly higher odds of borderline or overt diabetes as compared to non-Hispanic whites. Small sample size did not allow subgroup analysis by gender or age. Further, NHIS is conducted in English or Spanish thus limiting AIs with limited English proficiency, thereby possibly underestimating disease prevalence. Venkataraman and his colleagues (2004) surveyed a convenience sample of 1,046 AIs in Atlanta during religious congregations and reported an overall prevalence of diabetes at 18.3%, higher than all other racial groups in the U.S. Prevalence of diabetes was ascertained by the number of individuals with previously diagnosed T2DM and from undiagnosed cases (fasting blood sugar  $\geq 126$  mg/dl).

Cardiovascular disease refers to a class of diseases that involve the heart or blood vessels. It is a macro vascular complication of diabetes and affects migrant AIs disproportionately. Their age-standardized CVD rates and related morbidity and mortality are much higher than those of Caucasians and other ethnic groups (Yusuf et al., 2001). Asian Indians manifest a dyslipidemic pattern that includes hypertriglyceridemia, low levels of high-density lipoprotein cholesterol (HDL-C), and high levels of small, dense low density lipoprotein (LDL) that is proatherogenic and characteristic of insulin resistance (McKeigue et al., 1993; Misra & Vikram, 2004). In addition, studies have reported that AIs have a higher procoagulant tendency (i.e., increase the risk for CVD), high levels of homocysteine (hyperhomocysteinemia), greater endothelial dysfunction (i.e., inability to dilation or constriction of the blood vessels) and increased sub-clinical inflammation (deterioration in the health of the skin) than Caucasians (Chambers et al., 2001; Forouhi, Sattar, & McKeigue, 2001; Kain, Catto, & Grant, 2002; Misra, 2003). Many of these abnormalities commonly cluster together in the form of a metabolic syndrome (Misra et al., 2002). However, the mechanisms underlying insulin resistance have not been clearly defined for AIs. For example, the contributions of body fat distribution (visceral compared to subcutaneous fat) to insulin resistance, T2DM and CVD risk factors have received only marginal attention up to now (Ramachandran et al., 2004). Some of these factors are discussed in the following section.

### **Insulin Resistance**

The pancreas of a person with type 2 diabetes makes insulin, but the body does not use insulin properly—this is called *insulin resistance*. Although insulin resistance tends to run in families, excess weight and lack of physical activity also contribute since they reduce muscles' ability to use insulin. Many people with insulin resistance and high blood

glucose have high central obesity (excess weight around the waist), cholesterol, triglycerides and blood pressure, all conditions that put the heart at risk. This combination of problems is referred to as metabolic syndrome (MetS), or insulin resistance syndrome (formerly called Syndrome X). Metabolic syndrome is defined as a clustering of risk factors; presence of three or more of the following - abdominal obesity, low levels of HDL, high levels of serum triglyceride, high blood pressure, and high blood glucose levels - meets the diagnosis of MetS. Presence of insulin resistance and metabolic syndrome indicate high risk for diabetes and cardiovascular disease among individuals.

Reported prevalence of insulin resistance in migrant AIs ranges from 10-50% (McKeigue et al., 1993; Simmons & Powell, 1993; Snehalatha, Satyavani, Sivasankari, Vijay, & Ramachandran, 1999). The rates are consistently higher than in other Asian ethnic groups and Caucasians (Simmons & Powell, 1993; Whincup et al., 2002). Insulin resistance in AIs manifests early in life, even at birth (Yajnik et al., 2002) or during childhood (Dickinson, Colagiuri, Faramus, Petocz, & Brand-Miller, 2002). Furthermore, high insulin levels (hyperinsulinemia) and insulin resistance, prevalent in even 'non-obese' AI adults is associated with abnormal lipids levels and is believed to be a critical factor for contributing to the high prevalence of T2DM and CVD in this ethnic group (Misra, 2003). One study on US AI physicians and their relatives showed a higher prevalence of T2DM, high triglycerides and obesity, and lower levels of HDL-C compared to Caucasians (Enas et al., 1996). However, more studies are necessary for a careful investigation of the mechanisms and determinants of insulin resistance among migrant AIs in the U.S. Research on migrant AIs in the U.S. is limited, even with the utilization of either hospital-based or convenience samples.

## **Risk Factors for Diabetes and Cardiovascular Disease**

### ***Clinical Risk Factors***

Many studies suggest that "healthy" adult AIs, especially females, have abnormal body composition characterized by an excessive percentage of total body fat and abdominal fat (detailed below). This body composition may partially explain the occurrence of some of the risk factors (Deurenberg-Yap, Schmidt, van Staveren, & Deurenberg, 2000; Yajnik et al., 2002). Other abnormalities include higher visceral and subcutaneous truncal fat (Banerji, Faridi, Atluri, Chaiken, & Lebovitz, 1999; Chandalia, Abate, Garg, Stray-Gundersen, & Grundy, 1999; Raji, Seely, Arky, & Simonson, 2001). Further, AIs (both males and females) have lower waist circumferences but comparable ratios of waist-to-hip circumference compared to Caucasians. Such abnormalities may contribute to the development of insulin resistance and dyslipidemia as noted earlier. Studies show a 'westernized' lifestyle including changes in dietary habits and physical inactivity (elaborated in a later section), knowledge of and residence in a westernized country contribute to increase in

Table 3

*Prevalence of Diabetes in Asian Indians Living in US/Westernized Countries*

Author & year	Study group	Sample size	Geographic location	Measure of diabetes prevalence type of setting	Summary of findings
Ramachandran et al., 2001.	Men and women stratified sandom sample	5,288 men 5,928 women	Six major cities in India	National Survey by age	Diabetes and impaired glucose tolerance - 12.1% and 14.0%; <40 years - higher IGT; diabetes were high in urban India.
Ramaiya & Albert, 1990.	NIDDM in Migrant Indians	Men and women	Indian subcontinent	Prevalence of diabetes	NIDDM rates have either been underestimated or are raising.
Misra et al., 2001	Men and women urban slum population	170 males 362 females	City in northern India	Prevalence survey of atherosclerosis risk factors	Obesity, dislipidemia, diabetes mellitus increase in body fat, obesity in middle age, needs immediate attention in terms of prevention and health education. Diabetes mellitus 11.2% of males and 9.9% of females.
Zimmet et al., 1983	Malaysian and Indian population	Men and women (biracial)	Fiji Islands	Age standardized comparison of NIDDM & IGT	Physical factors such as obesity, diet, and stress contribute to differences. Genetic factors are important in producing diabetes in Indians.
Mohanty et al., 2005	Men and women	87,846 Non-Hispanic Whites 555 Asian Indians	Outside of US	Cross-sectional study using data from NHIS for 1997, 1998, 1999, and 2000	Asian Indians in U.S. have higher odds of being diabetic despite lower rates of obesity.
Ramachandran et al., 1992	Men and women	900 urban 1,038 rural	Urban and rural areas of southern India	Prevalence of NIDDM and IGT	NIDDM increased with age. Urban-rural differences were significant for NIDDM but not for IGT. High NIDDM in urban southern Indian Population.
McNeely et al., 2004.	Asian American men and women $\geq 30$ years	3,071 Asians; 12,561 Blacks; 12,153 Hispanic; 2,299 Native American; 626 Pacific Islands, 129,116 Non-White Hispanics	All 50 states, Guam, Puerto Rico, Virgin Islands	National Survey type 2 diabetes	Similar proportions of Asian and non-Hispanic white Americans have diabetes. When accounting for lower BMI of Asians, adjusted prevalence of diabetes is 60% higher in Asian Americans.
Venkataraman et al., 2004	Asian Indian men and women > 20 years	1,046 Asian Indians immigrants	In and around Atlanta metro area of Georgia	Community-based survey prevalence of diabetes mellitus	Overall prevalence of diabetes mellitus 18.3%. Prevalence is higher in Asian Indians than whites, blacks, and Hispanics living in U.S.

*Note.* NIDDM = non insulin dependent diabetes mellitus; IGT = impaired glucose tolerance; BMI = body mass index; NHIS = National Health Interview Survey.

overall and regional fat mass distribution that have not been investigated in U.S. AIs.

The average body mass index (BMI) of AIs and South Asians (individuals from India, Pakistan, Bangladesh and Sri Lanka) is lower than average BMI of Whites, Mexican Americans and African Americans. However, male and female AIs have higher BMI as they become affluent and urbanized. Furthermore, AIs seem to have a genetic phenotype of low BMI and high central adiposity compared to Caucasians and African Americans, also called the Yodanis-Yajnik paradox (Misra & Vikram, 2004; Yajnik et al., 2002). A high prevalence of abdominal obesity is characteristic of South Asians (McKeigue et al., 1993; Misra & Vikram, 2004). Although the average waist circumference in South Asians appears to be lower than in Caucasians, abdominal obesity is significantly greater among the former group, and much higher among females than males (Banerji et al., 1999; Raji et al., 2001).

A distinctive anthropomorphic feature in South Asians is thick subcutaneous fat (Banerji et al., 1999; Chandalia et al., 1999). Higher insulin resistance in AI men compared to BMI-matched Caucasians was explained by higher truncal skinfold thickness in the former (Chandalia et al., 1999). A significant association of truncal skinfold thickness with fasting hyperinsulinemia in children and adolescents also has been noted (Bhardwaj et al., 2008). Interestingly, thicker subscapular subcutaneous fat was present at birth in AIs compared to British neonates, and was associated with higher insulin levels (Yajnik et al., 2002). Hence thick truncal subcutaneous tissue may be an important correlate of insulin resistance in AIs. Obesity parameters are established risk factors for type 2 diabetes and prevention/intervention programs can successfully reduce or help prevent or delay the precipitation of this disease among AIs.

### ***Blood Pressure.***

Hypertension is a strong predictor of CVD mortality. AIs in the U.S. do not show an elevated risk for hypertension and coronary heart disease (Mohanty et al., 2005). Hypertension is not a consistent component of insulin resistance; however, it may be exacerbated by high salt intake, stress, smoking and weight gain – all factors prevalent in migrant populations. There are no reported population-based studies of the prevalence of hypertension in migrant AIs in the U.S.

### ***Blood Lipids and Lipoproteins.***

The lipid profile in AIs is characterized by high triglyceride levels, low levels of HDL (or the good cholesterol) and high levels of small, dense LDL (McKeigue et al., 1993; Misra & Vikram, 2004). These characteristic abnormalities commonly accompany insulin resistance and T2DM in AIs (Misra & Vikram, 2004). Low levels of HDL and high serum triglycerides are considered proatherogenic and conducive to the development of CVD. High intra-abdominal fat and truncal subcutaneous fat, also characteristically seen in AIs,

increase the systemic flux of free fatty acids and result in dyslipidemia. LDL levels among AIs in the United States are similar to whites (Enas, Chacko, Pazhoor, Chennikkara, & Devarapalli, 2007). In general, AI women are more likely to be diabetic and/or hypertensive, and have higher total cholesterol, low-density lipoprotein, and triglyceride levels than their male peers (Shammas et al., 2006). However, clinical practice guidelines issued by the National Cholesterol Education Program (NCEP) in 2001 are based on evidence from controlled trials in Caucasians; whether these guidelines are also applicable to other ethnic groups and both genders is unknown.

### ***C-Reactive Protein.***

C-reactive protein (CRP) is a marker of subclinical inflammation and high levels have been shown to predict heart disease, T2DM, and metabolic syndrome (Ridker, Rifai, Rose, Buring, & Cook, 2002). CRP levels in adult migrant South Asians are higher than in Caucasians (Chambers et al., 2001; Forouhi et al., 2001) and may be responsible for ~14% increase in CVD risk compared to Caucasians. The high CRP levels in South Asians could be explained by excess abdominal adiposity. Whereas CRP levels in migrant South Asians were correlated with insulin resistance (Chambers et al., 2001), investigations of young AIs residing in India have failed to show strong relationships (Vikram, Misra, Pandey, Dwivedi, & Luthra, 2004). A plausible reason is that CRP levels in the young population are largely determined by infections related to poor socioeconomic and unhygienic environmental conditions, which in turn may lead to transiently or persistently elevated CRP levels unrelated to abdominal obesity (Misra & Vikram, 2004). Mohan et al. (2005) have shown that CRP levels do not appear to mediate the relationship between body fat and CVD among AIs residing in India.

### ***Homocysteine and Lipoprotein(a).***

Studies have shown that AIs have higher homocysteine levels than whites (Chambers et al., 2001; Vikram et al., 2004), in association with low vitamin B12 and folic acid levels. Similarly, Lipoprotein a [also called Lp(a)] is a protein in the blood and higher levels indicate CVD risk. Higher levels of Lp(a) have been found in AIs, but more recent data are inconsistent in this regard (Tavridou, Unwin, Bhopal, & Laker, 2003). Hence patient education for this ethnic group should emphasize a proactive assessment of these risk factors for those with personal or family history of T2DM or CVD and educate individuals on understanding these novel risk factors.

### ***Non-Clinical Risk Factors***

Clinically measurable parameters do not account for all factors contributing to the development of T2DM and CVD. Many non-clinical factors may contribute to the early



onset of T2DM and CVD (Misra et al., 2000). The focus has been on psychosocial and behavioral domains as opposed to environmental and cultural domains of influence, as well as possibly unique cultural and environmental interactions (e.g., acculturation and utilization of health care, and changes in diet and physical activity). The ecological model stipulates an interplay of cultural and lifestyle/environmental factors in the onset of metabolic syndrome, diabetes and CVD (Bobak et al., 1999). Social Cognitive Theory has been used to predict adherence to certain diabetes-related outcomes, such as diet adherence, exercise, and self-monitoring of glucose (Chapman-Novakofski & Karduck, 2005). Additional components include beliefs and self-efficacy which have been linked to adherence to diet, physical activity, and improved glycemic control. Important cultural factors include ethnic customs and cultural and health beliefs that influence dietary intake and physical activity. Environmental factors that impact the incidence and complications of diabetes and CVD include socioeconomic status and health care access and utilization. An individual's degree of acculturation has an influence on dietary intake and utilization of health care (Sundquist, Winkleby, & Pudarc, 2001). Socio-economic status plays a decisive role in an individual's access to open spaces, sports equipment, and health clubs. This fact is supported by research indicating that low-income populations across all age groups suffer from higher rates of mortality and morbidity due to diabetes and CVD (Sundquist et al., 2001).

### ***Acculturation and Lifestyle.***

Immigrants who have lived in the U.S. for longer periods of time and with higher degrees of acculturation may have different lifestyles than those who report fewer years of residence or lesser degrees of acculturation (Kalra, Srinivasan, Ivey, & Greenlund, 2004). Food habits are changing among AIs in the U.S., particularly among adolescents, due to the attractive and aggressive advertisement campaigns of the fast food industry, low cost, and peer pressure to "fit in" (Perry, McGuire, Neumark-Sztainer, & Story, 2002). Changes include consuming fast food and increasing dietary fat, calories and salt. Each of these practices results in a less than adequate intake of foods of appropriate nutritional value (Lv & Cason, 2004). Activity profiles of AIs also vary based on socio-economic status and years of residence in the U.S. While some have become more aware of the benefits of physical activity and exercise (as defined by Surgeon General's report i.e., 5 times a week for at least 30 minutes), physical inactivity is still more common among AI migrants than other ethnic groups (Mohanty et al., 2005). Obesity also is linked to diet and lack of physical activity.

Among lifestyle factors, physical activity and tobacco use are important determinants of an adverse metabolic profile (Bhardwaj, 2008). Unfortunately, there are no well-designed cohort studies to assess the influence of lifestyle factors in immigrant AIs in the U.S. The genetic predisposition of AIs coupled with their physical inactivity and westernized diet

can lead to early onset of chronic diseases (Misra, Endemann, & Ayer, 2006).

### **Health Promotion and Health Education**

Although diabetes is a chronic debilitating disease, one can prevent or delay the early onset of T2DM and its complications through primary and secondary prevention measures. There is an association between increased urbanization or westernization and the rapid epidemiological rise in the disease among AIs (Mohanty et al., 2005). The sudden changes in the traditional lifestyles and dietary patterns are perhaps the main culprits in the steep rise of diabetes among this immigrant and high-risk ethnic group. Furthermore, physical inactivity and consumption of diets rich in fat, sugar and calories are potential culprits. Hence, a health-promoting lifestyle needs to be emphasized for this group (Blacconiere & Oleckno, 1999). Poor diet and physical inactivity are modifiable behaviors that can reduce obesity, T2DM and CVD among AIs in the U.S. Asian Indians are less active than Caucasians and less likely to meet the Surgeon General's recommendation for physical activity. Sedentary lifestyle is a critical factor for the development of insulin resistance and high risk for chronic disease. Hence, culturally appropriate physical activity programs are recommended. For example, use of new kind of "calorie-burning" cultural dance experience that combines Indian culture with fitness such as the "bhangra" dancercise can provide AIs with a vigorous and effective workout utilizing moves from traditional Indian folk dance with cardiovascular routine and is suitable for people of all ages and fitness levels. Physical inactivity is more pronounced among women and the elderly and thus age- and gender-specific programs to promote activity levels are recommended.

The benefit of health promotion and health education lies in reduction in high health care costs associated with T2DM morbidity and mortality as well as disease progression (Shah, 2005). Although the relative importance of genetic heritage, diet, exercise, socioeconomic status, culture, language, and access to health care in the prevalence, incidence, and mortality of diabetes is not clear, prevention of T2DM has been shown through intense lifestyle changes (diet and physical activity), more than the use of metformin (drug intervention), in the Diabetes Prevention Program (DPP) trial (Palmer, 2004). Recent research strongly supports targeting individuals at-risk or with pre-diabetes through therapeutic lifestyle change (Palmer, 2004). Lifestyle changes also are relevant to individuals with T2DM and affects their glycemic control through effective self-management behaviors that includes diet, physical activity, self monitoring of blood glucose, and medication (Palmer, 2004).

### **Role of Health Educators for Culturally Appropriate Prevention Programs**

Health educators are uniquely positioned to address the needs of immigrant AIs in a culturally appropriate manner.

High risk individuals i.e., those in the pre-diabetes stage and individuals with diabetes should be targeted with clinic- and community-based prevention/lifestyle intervention programs in order to reduce diabetes before its onset or prevent complications. Pharmacological intervention may be combined with behavior modification, if necessary. In order to identify these high-risk individuals, information on obesity, lack of exercise, childhood birth weight, and family history can be used to impress upon [these] individuals the seriousness of the risk (Palmer, 2004). Screening tools (e.g., the Archimedes model) are also available (based on age, waist, family history, etc for calculating the risk score) on the American Diabetes Association website ([www.diabetes.org/diabetesphd](http://www.diabetes.org/diabetesphd)).

Practical guidelines for AIs as well as health professionals working with Asian Indian clients needs to be presented for greater effectiveness. These include an emphasis on nutritional concerns and problems that stem from dietary changes among immigrant AIs such as altered vegetarian status, meal patterns, increased usage of fast and convenience foods, and the inclusion of other ethnic and American foods as substitutes for traditional foods. Hence, health educators can educate AIs regarding dietary guidelines for a healthy diet i.e., eating a wide variety of foods, balancing diet with physical activity, eating high fiber foods, such as whole grains, millets, fruits, vegetables and greens, use less added sugar and salt, and avoid foods high in saturated fat and cholesterol. Nutrition also is an important part of the treatment regimen for individuals with diabetes. Hence nutritional therapy for AIs should focus on maintaining optimal nutrition, education regarding portion sizes, modifying recipes for improved nutritional values, controlling blood glucose and preventing and treating related complications. Carbohydrate counting and exchange lists, low carbohydrate diets (e.g., avoid sugar and starches, avoiding soft drinks, etc) as well the use of traditional complex carbohydrates such as brown rice and chapatti instead of white rice or bread will help increase fiber intake. Protein intake should concentrate on lean meats, poultry, fish and the use of beans and cereal lentil combinations. Stepwise modification in diet is recommended if individuals are unable or unwilling to made drastic changes. For example, white rice can be substituted with white rice and beans and legumes, vegetables and mixed cereals progressively in steps. Reading nutrition labels using available literature such as the "Asian Indian cuisine and the management of diabetes" at [www.aapiusa.org/care/healthandnutrition.htm](http://www.aapiusa.org/care/healthandnutrition.htm) are encouraged.

Most AIs are well-educated and proficient in English. Hence, use of successful diabetes education programs can improve the knowledge of diabetes incidence and heightened risk factors with westernized lifestyle. Furthermore, barriers to use of prevention and screening behaviors can address why AIs with access to health care do not use preventive health services. Health educators can emphasize the use of wellness check-ups and screenings to detect diseases early thereby increasing opportunities for interventions

and treatment to prevent progression of the disease and complications as well as lowering the morbidity and mortality associated with diabetes. Programs for AIs should emphasize weight maintenance using the Asian criteria for overweight and obesity ( $BMI \geq 23$ ) and a focus on energy balance and calories to maintain a healthy weight. Use of faith-based organizations, such as temples, and health fairs are excellent avenues for this ethnic group to advocate lifestyle intervention and address acculturative changes. Gender specific issues also are important since sedentary lifestyle is greater among females and lack of use of health services is greater among male AIs (Misra et al., 2000).

Although most AIs are well-educated and generally of high socioeconomic status, disease specific knowledge may be lacking given their high rates of diabetes, heart disease, and sedentary lifestyle. Health education can increase knowledge of diabetes and other chronic diseases. Not all AIs, however, are proficient in English. Recent immigrants (who are family members) may have problems communicating with health professionals due to language and cultural differences. Since there is limited literature about health education for AIs, literature on diabetes health education for minorities (e.g., Mexican Americans) may be useful. Cultural assessment prior to instituting health education programs and the development of innovative and culturally acceptable health education methods such as storytelling traditions are important. We also have much to learn from health education techniques currently being used in India, such as raising awareness of diabetes in the community, diabetes education camps (Viswanathan, 1986) and the use of trained community members (lay leaders) to give simple health education advice to their peers.

## Conclusion

AIs in the U.S, a growing and high-risk ethnic group, are inappropriately considered the "model minority," a myth that is highlighted in this paper. With national studies are incapable of assessing prevalence and risk factors for Asian subgroups, national (epidemiological) studies on AIs can help quantify the incidence/prevalence rates and understand the epidemiology and modifiable/behavioral risk factors of T2DM and CVD in this group. Genetic predisposition to diabetes and heart disease is confounded by acculturative changes that occur with westernization and increase the incidence and prevalence rates. Culturally appropriate dietary education and physical activity programs are necessary to reduce premature morbidity and mortality.

Health education and health promotion can emphasize the preventive strategies and benefits of primary and secondary education to improve wellness checkups and screening for early diagnosis. Dietary changes are also necessary to avoid high carbohydrate foods and nutrition labels on ethnic foods need to be made available and encouraged by restaurants and ethnic food stores.



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